

CLAIMS:

1. An optical scanning device for scanning in a first mode a first type of record carrier having a first information layer and a first transparent layer of a first thickness and for scanning in a second mode a second type of record carrier having a second information layer and a second transparent layer of a second thickness different from the first thickness, comprising a radiation source for generating at least one radiation beam and an objective system designed for operation at a first set of conjugates to form a focus at the first information layer in the first mode and for operation at a second, different set of conjugates to form a focus at the second information layer in the second mode, characterized in that the device comprises an optical element, arranged in the radiation path in the second mode from the radiation source to the objective system, for introducing spherical aberration in the radiation beam.

2. An optical scanning device for scanning a record carrier having an information layer, comprising a radiation source for generating a non-collimated radiation beam and an objective system for converging the non-collimated radiation beam to a focus on the information layer, characterized in that the device comprises an optical element arranged in the radiation path from the radiation source to the objective system for introducing spherical aberration in the non-collimated radiation beam, the spherical aberration having a sign opposite to the sign of the spherical aberration of a positive plano-spherical lens.

3. Optical scanning device according to Claim 1 or 2, wherein the objective lens introduces spherical aberration, and the spherical aberrations of the objective lens and the optical element have opposite signs.

4. Optical scanning device according to Claim 1 or 3, wherein the spherical aberration of the optical element has a sign opposite to the spherical aberration of a positive plano-spherical lens.

5. Optical scanning device according to Claim 1, 2 or 3, wherein the optical element is a positive lens, a grating or a thin layer having a position-dependent optical path.

6. Optical scanning device according to Claim 1, wherein a first collimator lens is arranged in the radiation path between the radiation source and the objective system in the first and second mode, and the optical element for introducing spherical aberration is a second collimator lens arranged in the radiation path between the radiation source and the objective system in the second mode only.

7. Optical scanning device according to Claim 1 or 2, wherein the optical element introduces an amount of spherical aberration $W40$ (rms) substantially equal to

$$\frac{W31(rms)}{\left(\frac{4x}{R}\right)} \sqrt{\frac{72}{180}}$$

where $W31$ (rms) is a predetermined amount of coma with which coma introduced by the objective system when displaced by a distance x in the second mode is reduced, x is a displacement of the objective system from a centred position in a direction perpendicular to an optical axis of the objective system, and R is a radius of an entrance pupil of the objective lens.

8. Optical scanning device according to Claim 7, wherein the radiation beam has a radius R_1 larger than R in a plane of the entrance pupil, and the optical element introduces an amount of spherical aberration in the radiation beam substantially equal to

$$\left(\frac{R_1}{R}\right)^4 W40(rms)$$